NON-TECHNICAL SUMMARY

Study Title: Review of Existing and Emerging Environmentally Friendly Offshore Dredging Technologies

Report Title: Review of Existing and Emerging Environmentally Friendly Offshore Dredging Technologies

Contract Number: 01-03-CT-71516

Sponsoring OCS Region: Headquarters–Sand and Gravel Unit, Leasing Division

Completion Date of Report: November 2004

Costs: FY 2004: $176,663.85

Project Manager: Robert B. Nairn, Ph.D., W.F. Baird & Associates Ltd., 2981 Yarmouth Greenway, Madison, WI 53711

Principal Investigators: Robert Nairn, Tim Kenny, Fernando Marvan, Jacqueline Michel, Nick Bray and Richard Newell

Key Words: sand resources, OCS, dredging, ecological impacts, environmentally friendly equipment and approaches

Background: The Minerals Management Service (MMS) is charged with environmentally responsible management of Federal Outer Continental Shelf sand and gravel resources, that is, those resources lying seaward of the State/Federal boundary. MMS has responsibility for providing environmental analysis and assessment information enabling the responsible management of the OSC sand resources. There is a range of environmental concerns, including both direct and indirect impacts, with the dredging operations necessary for sand borrow extraction. This project was initiated to evaluate the extent to which recent developments in offshore dredging equipment and practices may lead to more environmentally friendly results.

Objectives: The goal of the project is to evaluate dredging equipment and techniques on a worldwide basis to identify existing and emerging dredging technologies that aim to reduce or avoid potential adverse effects on the offshore biological and physical environment. Based on the results, recommendations are developed for an implementation strategy for any promising technologies.

Methods: The project approach was comprised of four main areas of activity: a literature review of dredging impacts and existing and emerging environmentally friendly dredging technologies; interviews with representatives of the various regulatory agencies at the Federal and State level that are responsible for the offshore environment of concern to prioritize areas of concern; direct survey of US and overseas dredging contractors; and finally, in a workshop setting an evaluation of the various approaches and techniques for their appropriateness, practicality, and effectiveness as they relate to the key impacts was completed.

Significant Results: The focus was primarily on Trailer Hopper Suction Dredges as these are the most likely vessels of choice for dredging operations where the borrow deposit and the

project site requiring the sediment are several kilometers or miles apart. However, in some cases Cutter Suction Dredges and Dust Pan Dredges may also be utilized so these have also been considered.

A short list of impacts was developed for detailed investigation by focusing on those issues which were not being actively investigated through other MMS or other agencies, and which did not have sufficient existing MMS stipulations. In order of priority ranking based on discussions with the resource agencies in the US, the short list included: direct loss of entire benthic communities; changes in the substrate characteristics (grain size, dissolved oxygen, compaction and organic content) that lead to a reduction in benthic communities and suitability of the area for future dredging; sedimentation (burial) impacts to adjacent hard/live bottom or other sensitive habitats; and, impacts from short-term increased turbidity from cutterhead or draghead and overflow from hopper dredges on benthic communities. Other key concerns such as impacts to turtles, shoreline impacts through changes to wave climate, spatial and seasonal conflicts with recreational and commercial fishermen, potential damage to pipelines, damage to archeological resources, and potential harmful alteration or destruction of Essential Fish Habitat are being or have been recently addressed in other MMS (and USACE in the case of sea turtle impacts) studies. The impact to Essential Fish Habitat was discussed in a preliminary manner during the project workshop and some other recommendations were developed. The existing stipulations for collision with marine mammals were determined to be sufficient.

The literature and industry review found that he US dredging industry is not lagging the European market in development of innovative approaches. The key area of difference between the US and European dredging industries was the size of hopper dredges. Within a decade in Europe the maximum hopper size of Trailing Suction Hopper Dredges has moved from around 12,000 m^3 to in excess of 35,000 m^3. In contrast, in the US, the largest hopper dredges are the Great Lakes Dredge & Dock Liberty Island (5,000 m^3) and Bean Stuyvesant (8,360 m^3). With respect to dredging impacts, the primary implication of this difference is that almost all of the recent research on hopper design (and efficiencies related to the overflow process) has been completed in Europe. However, US dredging contractors ultimately benefit from these developments.

From the industry survey and the literature review it was apparent that most approaches and equipment development has focused on reducing turbidity levels associated with overflow from hopper dredges. These various efforts have reduced the sedimentation footprint associated with the overflow plume to extending no more than about 200 m beyond the dredge area, at least at locations where ocean currents are not strong. Very little if any development in either equipment or dredging approaches has been devoted to the key issue of loss of benthic communities, which was identified by resource managers as the most important impact.

The key recommendation for addressing the loss of benthic habitat was developed by the team as part of the study and consists of designating undisturbed refuge areas within a borrow area to accelerate benthic re-colonization. It is recommended that this approach should be field-tested and evaluated. If successful, it should be implemented at those locations where the benthic communities have high ecological importance.

It is appropriate to determine a local maximum pit depth to avoid development of a mud cover and/or anoxia. The minimum practical pit depth would be greater than 1 m from TSHDs and greater than 2 m for CSDs. Maximum pit depths should be determined on a site-specific basis through analysis combined with monitoring where necessary.

Where there is a need to protect hard/live bottom areas or coral habitat from sedimentation, field-tested sedimentation limits should be established for different types of sensitive habitat. A blanket buffer zone width for all locations is probably unjustified. Another way of defining acceptable site-specific sedimentation levels, that may be more expedient, is through the monitoring of natural sedimentation rates. Once sedimentation limits are established for the local sensitive habitat, the best approach would consist of a pre-dredging assessment of the plume sedimentation footprint using the MMS Plume model, followed by real-time or near real-time monitoring of sedimentation levels.

It is generally viewed that elevated levels of turbidity generated from Trailing Suction Hopper Dredge operations in open ocean waters does not represent a significant ecological impact. It is believed that adult fish can avoid plumes and that other organisms can survive the sub-lethal levels of short-term elevated turbidity. Nevertheless, the dredging industry is currently able to meet relatively restrictive limits on turbidity levels that have not been scientifically linked to impacts in the offshore environment. Some key equipment types and modifications that are widely in use both in the US and Europe to limit the size of sediment plumes include the Anti-Turbidity Valve and below hull release of hopper overflow.

There is much to be learned about the processes that maintain the form of shoals, and therefore, the potential impacts of dredging sand from these features. The development of guidelines for the removal of sand through dredging (specifically, how much and where) will require several lines of investigation including: a review of shoal morphometrics (as C. Spaur of the USACE, Baltimore District has initiated); an investigation of the sedimentology and stratigraphy of these features; and numerical modeling of waves, sediment transport and morphodynamics.

Study Products: W.F. Baird & Associates Ltd. and Research Planning Inc. 2004. Review of Existing and Emerging Environmentally Friendly Offshore Dredging Technologies. U.S. Department of the Interior, Minerals Management Service, Sand and Gravel Unit, Leasing Division, Herndon, VA. OCS Report MMS 2004-XXX, XX pp. + appendices.